

STOVL Air Power: The Ramps, Roads, and Speedbumps to Exploiting Maneuver Air

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**STOVL Air Power**

*The Ramps, Roads, and Speedbumps to Exploiting  
Maneuver Air Warfare*

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**STOVL Air Power**  
***The Ramps, Roads, and Speedbumps to Exploiting***  
***Maneuver Air Warfare***

The Navy-Marine Corps Team will never fully appreciate the incredible combat power offered by maneuver air warfare until it exploits the capabilities of and employment concepts for the next generation short-takeoff and vertical-landing (STOVL) aircraft. The 31st Commandant's Planning Guidance states that as the Marine Corps progresses into the 21st century, one goal is to achieve an all STOVL aviation component. In doing so, it will "[provide] effective support to the Marine Air Ground Task Force (MAGTF) across the spectrum of conflict and enhance its expeditionary utility."<sup>1</sup>

***Closing the Gap***

Marines have operated STOVL aircraft for nearly a quarter century. During that time, the United States has failed to exploit STOVL aircraft utility. First, operational requirements directed a limited-mission, light attack, close air support (CAS) aircraft during a time when multi-role strike fighters were evolving. Second, the STOVL aircraft's inherent design forced deficiencies in range, speed and payload compared to multi-role conventional platforms. Finally, "the U.S. [has] not invested resources in STOVL or [advanced STOVL technology] comparable to the investments made during development of the F/A-18 or F-15E."<sup>2</sup> However, all that is changing.

The future STOVL aircraft now in the design and development stages falls under the Pentagon's Joint Advanced Strike Technology (JAST), more recently referred to as the Joint Strike Fighter (JSF), program. The JAST program's mission is to provide the Air Force, Navy, Marine Corps, and potentially a foreign market, with a low cost, multi-role strike/fighter whose

deliveries will begin around 2007. Only the Marines want a STOVL JSF, but the British have shown interest in the STOVL variant as well. Both the Air Force and Navy JAST designs are conventional. The Navy's aircraft will be carrier capable. Currently, the JSF is a single-seat, single-engine design capable of super-sonic dash, a combat payload possibly up to 12,000 pounds, and a range of more than 500 nautical miles. The STOVL version (with enough wind over deck) "will take off with a 700-foot roll [and] almost as much payload as the Navy version."<sup>3</sup> From three competing industry teams, two finalists will build two prototypes each of the more promising designs, one of which may be a STOVL variant. One industry team then will earn full-scale production rights for all three service aircraft types. Evidently, initial designs show the capability gaps between conventional and STOVL aircraft are closing. The increased United States commitment to STOVL research and development, due mainly to its joint-requirement flavor, increases the likelihood that an all STOVL tactical aviation (TACAIR) component will meet the Commandant's Planning Guidance goals. However, some capability gaps have military and industry officials concerned.

U.S. Air Force General George Muellner, previously head of JAST, believes "...the advanced STOVL is unlikely to meet the range and payload requirements of the Navy mission."<sup>4</sup> He also doubts STOVL designs will meet stealth requirements since they carry external weapons. "It would be extremely difficult to design an advanced STOVL aircraft with total internal weapons carriage that could meet weight limits."<sup>5</sup> Unlike a conventional aircraft, the STOVL design requires augmenting the airframe with lift devices that allow slow, vertical, and hovering flight. These devices, too, impact STOVL range and payload.

One industry executive states, "Lift devices would be removed in the non-STOVL

JAST variants with the lift fan behind the cockpit replaced with additional fuel."<sup>6</sup>

Obviously, this means the STOVL aircraft may have less range than its conventional JAST siblings.

### ***A Simple Solution***

Certainly the Navy-Marine Corps Team (the Team) realizes the inherent gaps that exist in its STOVL JAST aircraft: less range; less payload when operated *as intended* in a STOVL environment; and perhaps less of an avionics suite because of overall weight constraints. However, so far there is little indication the latter is of major concern. The challenge to military and industry leaders now is how to close these gaps even more and preferably erase them. Perhaps industry has considered everything within time and budget constraints to close the gaps, and except for future technological advances, they always will exist. If the Team accepts that (it's reasonable to believe it will), what can it do otherwise to offset it or, better yet, close it completely?

The Team can commit *now* to exploiting a simple, technologically proven piece of hardware -- *the RAMP* -- and employing the related operational concepts that not only close the gaps, but propel multi-role STOVL aircrafts' utility well ahead of that from like-mission conventional ones. The United States' National Security Strategy requires the Navy-Marine Corps Team to maintain a naval presence, and when called upon, project combat power worldwide. Continual reductions in manpower and procurement dollars make this an ever-increasing challenge. Marine TACAIR is a critical component of this Team and therefore has as much at stake as any other Navy or Marine component. However, with some cost-effective improvements not only in how, but with what, the Team projects power, it can improve in fulfilling national security

requirements around the globe. These changes can occur only through cooperation between the Navy and Marine Corps. The Navy must understand that an all STOVL Marine TACAIR component enhances the Team's overall power projection and expeditionary utility if improvements to ships and in STOVL employment occur. The Marines must understand that without the Navy's ships and cooperation, its all STOVL aviation component offers no more utility in maneuver air warfare than a conventional one. Also, the Marines must exploit STOVL utility and land basing concepts ashore better than they have over the past quarter century. Only through proving STOVL aircraft as equally accomplished on land and at sea as any other services' conventional aircraft can the Team provide effective support to the Marine Expeditionary Force (MEF), Naval Expeditionary Force (NEF), or Joint Force Commander (JFC) across the conflict spectrum.

### ***Basing Flexibility***

The Marine Corps is pursuing an all STOVL aviation component for one reason -- basing flexibility. Marine TACAIR's specialty is its ability to project air power from both sea and land bases in support of the MEF, NEF, or Joint Force Commander. The basing flexibility concept relies on roads, highways, expeditionary airfields (EAFs), Tarawa and Wasp class big-deck amphibious assault ships (LHAs and LHDs), aircraft carriers, and conventional runways. Other U.S. services (the Air Force and Navy) primarily depend on either existing conventional runways or aircraft carriers. In a world of less predictable conflicts than during the Cold War era, conventional runways, host nation support and regional over-fly rights may not exist. Aircraft may already overcrowd and overuse available runways. The solution in these scenarios lies in exploiting basing options and employment concepts for which STOVL air power serves best -- at

sea or on land, or both.

Marines expect operations other than war: low-intensity, humanitarian service; mid-intensity, high violence gang wars; firepower-driven border, religious, or ethnic disputes. With eighty percent of the world's population within 100 miles of coastal waters, the likelihood that the next contingency will be in a littoral region is high. An integral part of projecting Marine presence and firepower ashore is the Navy. The Navy transports Marines, their weapons, and limited sustainment to the littoral region, then provides the additional sea and air power to insure success at all levels of conflict. Additionally, the Navy provides the sea based platforms from which Marine TACAIR projects much of its firepower. As Marines transition to an all STOVL TACAIR component, their reliance on the Navy grows more critical to provide the most capable sea based platforms possible within budget constraints. Current amphibious assault ships deny STOVL aircraft full combat payloads. Carriers would do the same, but they never employ STOVL TACAIR. Therefore, *now* is the time to prepare (structurally and willingly) both type ships to exploit future STOVL air power. Until the ships are ready and their crews are willing to maximize STOVL aircraft firepower from the sea, the total combat power of the Marine Expeditionary Force (MEF) will stagnate.

### ***Amphibious Ships***

The most significant contribution that the Navy could make to STOVL air and helicopter-borne power projection is adding a ramp (ski jump) to all Tarawa- and Wasp-class amphibious assault ships. The technology is proven and for return on investment relatively inexpensive. A ramp not only improves dramatically a STOVL aircraft's takeoff performance, it facilitates concurrent fixed- and rotary-wing operations afloat. Of all countries that operate

STOVL aircraft (the United States has more STOVL aircraft and ships to employ them than anyone) the United States is the only country without a ramp-equipped STOVL assault ship.

*Now is the time for ramps.*

A STOVL aircraft requires neither a catapult nor an arresting gear to operate at sea. After a short full-power deck run, the pilot vectors the thrust downward as he approaches the ship's bow. He then transitions to conventional flight by vectoring thrust aft and accelerates in the "free air" off the bow. Ramps provide more free air in the upward trajectory. "The greater an aircraft's thrust-to-weight ratio, the more it can accelerate during this 'free' period."<sup>7</sup> A STOVL aircraft is an ideal candidate for ramps. Amphibious assault ships (LHAs and LHDs) offer 750 feet for deck runs. The JAST STOVL aircraft will probably require the entire deck to lift a combat load that is "almost as much as the Navy version." It does not have to be that way; "almost as much" is not good enough.

A nine- to twelve-degree ski jump and probably 20-30 knots wind over deck (an LHA and LHD can generate that much wind under most sea conditions) could reduce the takeoff roll by half. The ramp is proven.

The Harrier's takeoff performance was dramatically enhanced; the heaviest Harrier -- 31,000 pounds -- ever from the deck of any ship was launched from the [Spanish carrier, Principe de Asturias] with a deck run of only 400 feet. An aircraft whose weight precluded its launch from any LHA or LHD, even using the entire deck, used the ski jump to take off in approximately one-half that distance.<sup>8</sup>

With a ramp installed, the future STOVL aircraft with its high thrust-to-weight ratio could take off from an LHA or LHD carrying an *equal* combat load to that of the Navy's conventional JSF using catapult assistance. Ship maneuvering could increase the STOVL aircraft's lethal range by sailing closer to the battlespace or target area but remaining within the

aircraft carrier's defense umbrella, if required.

A ramp does more than just assist the STOVL aircraft in its launch. It allows for more fluid deck activity during concurrent fixed- and rotary-wing aircraft operations, vital to successful air and ground power projection ashore. With 400 feet forward dedicated for fixed-wing operations, the ship's aft section deck crew could concentrate entirely on rotary-wing and MV-22 launches and recoveries. Currently, on flat-deck amphibious assault ships, concurrent operations are difficult at best. For example, during a recent major amphibious exercise, there were significant problems "coordinating launch cycles with helicopters and AV-8s, [therefore restricting] rapid build-up of combat power ashore [and] dramatically [reducing] the responsiveness of aviation assets."<sup>9</sup> The Amphibious Task Force commander cannot afford disputes over limited deck space, especially during forcible entry-type operations when Marines require maximum air and ground power projection ashore.

The skeptics insist that ramps will displace landing spots. Tests prove otherwise.

On a 12 degree ski jump approximately 150 feet long, the slope gradually increases from zero up to 12 degrees at the bow. The first half of the ski jump has a slope no greater than that of an LHA during wet-well operations with the well-deck flooded – both Harriers and helicopters can land on it.<sup>10</sup>

The ramp not only bolsters a STOVL aircraft's combat payload to its maximum and enhances fixed- and rotary-wing interoperability, it provides a margin of safety to the pilot in emergency situations. The upward vector off the bow offers the pilot extra precious seconds to handle takeoff emergencies and an expanded ejection envelope if required. The price of one saved STOVL aircraft, and potentially the pilot's life, would probably fund several ramps on amphibious ships. The Navy and Marine Corps need ski jumps on the big-deck amphibious ships.

Unquestionably, an LHA and LHD could never replace an aircraft carrier in total air power projection or air space dominance; however, if task organized properly, either could greatly augment it. The Chief of Naval Operations claims, “An aircraft carrier brings a full range of aviation capabilities...[and] doesn’t require host nation support [whereas] amphibs...help get troops across the beach, move inland, and...hold the door open for follow-on forces.”<sup>11</sup> Yet, in today’s wide spectrum of potential conflicts it is conceivable that continual sea based air power would precede and continue during an amphibious assault or ground offensive. Two STOVL JSF squadrons (perhaps 32-36 aircraft) could potentially *double* the offensive strike capability of a single carrier. On a dedicated fixed-wings STOVL amphibious deck with all sorties committed to offensive air support, the LHA or LHD’s *offensive* sortie generation rate would match or exceed that of the carrier’s. For example, a *single* Harrier squadron (20 aircraft) flew 56 combat sorties in under nine hours from the USS Nassau in Desert Storm without in-flight refueling. Weather forced it to cease operation that day. A ramp-equipped ship could have doubled each aircraft’s ordnance load to 4-6,000 pounds, and separate and concurrent helicopter operations could have taken place. A multi-role STOVL-heavy LHA or LHD could join with a surface air defense combatant to assist the carrier in maintaining air space and sea dominance. The possibilities are only as limited as the desire to employ them.

Multi-role strike aircraft carry the right ordnance mix for the mission. Likewise, multi-role ships such as the LHA and LHD certainly can do the same with a specialized mission aircraft mix. They can task organize heavily for either ground or air offensive operations or, as with the Marine Expeditionary Unit or MEF, balance each for numerous contingencies. A ramp serves any size MEF equally. The MEU benefits especially because of the limited number of STOVL aircraft (typically six). It is critical that when a MEU projects air and ground combat

power ashore, all of its aviation assets are fully laden with either Marines or ordnance. The ski jump offers the MEF greater offensive striking power regardless of the number of STOVL aircraft embarked. The Navy and Marines must make every effort to install them on amphibious ships now to ensure maximum combat power to the MEF, NEF, and Joint Forces commanders.

### ***Aircraft Carriers***

Although ski jumps are critical to projecting air power from amphibious ships, they are just as beneficial on aircraft carriers as the Marine Corps transitions to an all STOVL aviation component. Marine F/A-18 Hornets regularly integrate into the Carrier Battle Group (CVBG). If Marine aviation continues to deploy on carriers, it is time to test the waters with STOVL aircraft. The CVBG must begin incorporating a STOVL squadron now to prove or disprove STOVL utility and integration on aircraft carriers. This presents a challenge.

Rarely do Harriers venture aboard aircraft carriers, and so far never for combat operations. In the Navy's view, it makes no sense to integrate STOVL aircraft aboard a sea base perfected for conventional air power projection. The Navy's commitment to an all conventional TACAIR component is obvious from plans to purchase 1000 F/A-18E/Fs and 300 conventional carrier JSFs. When questioned about future integration of Marine STOVL aviation aboard aircraft carriers, a senior Naval Flag officer reconfirmed the Navy's desire for 1000 F/A-18E/Fs and implied that, yes, the Marines might have some problems integrating STOVL aircraft onto carriers.<sup>12</sup> However, indications that perhaps the Navy does envision STOVL aircraft on carriers exist.

A final decision has not been made, but the USN is reviewing whether it could deploy, for the first time, an integrated system combining a small ski jump with a catapult. This would allow aircraft to take off at lower speeds while maintaining fuel/ordnance payloads. The high technology engines and powered lift of the STOVL JAST means 'the navy might not need the large energy of steam catapults.'"<sup>13</sup>

Some STOVL proponents think the Navy needs even more radical changes to its aircraft carriers. Rear Admiral George Jessen believes the Navy "...should remove two steam catapults and one jet blast deflector...and replace them with one fixed steel ramp that would be capable of launching 75% of the [carrier's] air group."<sup>14</sup> He suggests the same type ramps for LHAs and LHDs. For overall combat power, ramps on both aircraft carriers and amphibious ships provide maximum gross weight takeoffs to STOVL aircraft and most of the carrier air group (without using a catapult). They offer dual-deck flexibility for STOVL aircraft. More importantly, they potentially double the CVBG's offensive strike capability when teamed with a STOVL-heavy LHA or LHD. The implications for cost-effectively increasing and projecting air power at sea are staggering.

### ***Land Basing***

Sea-based platforms are not the only places where ramps are effective. The Marines must focus on their employment once phased ashore. An all STOVL aviation component provides the Marines an opportunity to double its current EAF capability by simply installing ramps at each end. Today's typical 4,000-foot EAF would decrease to less than 2,000 feet using ramps, yet still provide a maximum gross weight takeoff capability to STOVL aircraft. Additional EAF matting provides vertical landing spots and parking space if needed. More over, ramps provide almost limitless EAF locations wherever there is a straight quarter-mile stretch of road or highway. Korea and Sweden, for example, have designed much of their highway systems for use as conventional runways. A STOVL aircraft requires a mere fraction of that if augmented with light-weight, high-strength modular ramps. Smaller EAFs provide several advantages. A reduced footprint makes it less susceptible to targeting and the chance of being hit. Reduced construction time, especially when a road or highway is used as the runway, maintains operational tempo.

They are more easily relocatable when the mission dictates. They are easier to camouflage and defend because of their size and ideally their location. EAFs allow aircraft spread loading away from a main conventional base and the congestion of other service and support aircraft. Logistically, the multiple-EAF concept is probably harder to support depending on the country or state's infrastructure and available manpower and transportation. Also, command and control challenges would require attention. Emerging and existing communication technologies, properly employed, may offset much of the difficulties in centralized command and decentralized control, a major component in maneuver warfare. However, once established and adequately supported, EAFs along with all the other basing options to exploit STOVL utility allow for effective maneuver air warfare.

### ***Maneuver Air Warfare --A Scenario***

Recent history has shown that the potential for effective maneuver air warfare at the operational level exists. Desert Storm provides a vision for the future although STOVL aircraft employment was more conventionally than STOVL oriented. All Harrier squadrons but one operated from a conventional 8,000-foot runway or shorter EAF along with conventional TACAIR. The one squadron at sea on an LHA flew combat sorties for nine days, but virtually free of concurrent helicopter operations. Had STOVL employment concepts been expanded, ramps been used both ashore and afloat, and roads been utilized, perhaps the Marines would not be the only service signing up to the STOVL version of the JSF. The United States was fortunate because the countries' infrastructures provided just enough airfields from which to base aircraft. This good fortune fostered little motivation to exploit STOVL basing options, perhaps one reason why STOVL employment concepts lag what the STOVL aircraft has to offer. STOVL

aircraft, deployed and employed as intended with ramp-equipped ships and ramps on EAFs and roads, truly represent the future in maneuver air warfare across the spectrum of conflict.

The year is 2010. Iraq has had 15 years to rebuild its military strength and hints at rolling south. Somalia remains subjected to gang wars and famine, and the Balkans have reignited their border and ethnic disputes. The United States, still the world's super power, is asked to intervene in each case, all within weeks of each other. The President is compelled to do so.

It requires some imagination to envision all LHAs, LHDs, and even a few aircraft carriers equipped with ramps. Imagine, too, two all-STOVL TACAIR Marine Aircraft Groups (MAGs) within a Marine Aircraft Wing (MAW) with the organic assets to erect three or four 1,500-foot ramp-equipped EAFs unloaded from Maritime Prepositioned Ships (MPS). MV-22s provide the medium-lift, and CH-53Xs, the heavy-lift requirements within the MAW. Four LHAs or LHDs accompany other ships within two reinforced Amphibious Ready Groups (ARGs) and three CVBGs. The ARGs have two MEF (Forward) brigades embarked. The four big-deck amphibious ships carry mostly MV-22s and 64 STOVL JSFs (one squadron of 16 aircraft per ship). Attack helicopters are spread throughout the ARGs. The other MAG aircraft await Air Force tanker support two weeks away. Air Force C-17s and conventional fighters are mobilizing, and the Army has placed the 18th Airborne Corps on alert.

The air threat over the Balkan states is minimal; therefore, the first ship in theater, a ramp-equipped aircraft carrier, sends half of its strike package to operate from Italy. It continues into the Red Sea and there receives a squadron of STOVL JSFs from an Air Force refueler along with a small maintenance crew delivered by MV-22. STOVL JSF repair parts are 75% common with the conventional JSF, so STOVL support already exists. STOVL peculiar high-use items

accompany the maintenance crew. The second aircraft carrier enters the Persian Gulf from the Indian Ocean and receives orders to strike Iraqi troops attempting to cross into Kuwait or Saudi Arabia. Near southern Italy, one reinforced MEF(Forward) detaches a MEU consisting of an LHA with 16 STOVL JSFs to augment the Navy's (and by now the Air Force's) land-based aircraft that provide CAS and protection for the Marines and follow-on Army personnel tasked with peacemaking in Bosnia.

Near Somalia, another MEU detaches. It is an MV-22-heavy MEU with only six STOVL JSFs. Immediately, Marines go ashore and seize the badly damaged runway. They erect modular ramp components, brought in by the MPS and lifted ashore by CH-53Xs, at each end of the 1,500 feet of usable runway. STOVL JSFs stage ashore. The remainder of the ARG continues into the Persian Gulf and marries with two CVBGs. The third CVBG stations itself in the Red Sea to assist either the Somalia or Southwest Asia effort. The Somalia STOVL JSFs fly CAS and armed reconnaissance missions, then re-embark to muffle a flare-up 150 miles south. They remain sea-based, but continue to use the northern EAF to rearm and refuel when engaged in that vicinity.

Marines and Army personnel fly into Saudi Arabia to off load the bulk of the MPS. Within a week, a construction crew establishes a 2,000-foot EAF north of Kuwait City. A STOVL JSF squadron, a Marine company-size security force, and four MV-22s occupy this forward EAF and outpost. The island of Failaka, ten miles off the northeast Kuwait City coastline, receives another STOVL JSF squadron that operates from a stretch of highway. Other STOVL aircraft remain afloat as the rest of the MAW's STOVL assets arrive in Saudi Arabia by Air Force tankers and C-17s.

Immediately, construction begins on another 1,500-foot EAF near the Kuwait-Saudi Arabia border. Within a week, a STOVL squadron from the main base is operational there. Marines also evaluate three separate 2,000-foot highway sections along the Kuwaiti coastline for future STOVL sites. They build ramp modules and preposition them forward near the potential highway EAFs along with two day's of fuel and ordnance. Iraq moves south.

The two forward-most EAF squadrons and squadron (minus) afloat receive missions to delay Iraqi armor movement south along major avenues of approach while conventional carrier TACAIR strike major communication and supply routes. A reinforced battalion arrives by M-22s into Kuwait City's International airport. Two hours later, the squadron (minus) afloat returns from missions in southern Iraq and lands on the taxiway, its new EAF. By the second day, lead elements of an Iraqi armored brigade force the EAF north of Kuwait City to evacuate. The squadron and personnel abandon the site, divide equally and fall back to the International airport and northern-most pre-planned highway EAF south of Kuwait City. Fuel and ordnance are there. The Failaka-based STOVL squadron continues the delaying action, reinforced by the JSFs from the CVBGs. The STOVL aircraft Group just arriving in Saudi Arabia moves another squadron forward to the EAF on the Kuwait-Saudi Arabia border and one to an LHD that has cross-decked its helicopters to another platform. The LHAs and LHDs temporarily move STOVL JSFs to just one deck to facilitate strictly fixed-wing operations. Along with the two CVBGs, they then move north in the Persian Gulf and begin deeper strikes into Iraq.

Somalia is under control, and the six STOVL JSFs fly aboard the CVBG in the Red Sea. Once far enough north, the STOVL aircraft depart to join with a tanker that offers a top-off before their flight to Saudi Arabia. Enroute, the airborne commander tells them to land at the

EAF along the Kuwait coastal highway because the Saudi Arabia main conventional base suffered heavy runway and apron damage during a SCUD attack. They receive the coordinates, transfer to the final controller, and execute an instrument approach. Two days later, they join one of the CVBGs in the northern Persian Gulf. Successful peacemaking operations in the Balkans permit the MEU's STOVL JSFs to detach and join the aircraft carrier in the Red Sea...and so on.

As aircraft require maintenance above routine, small specialized "maneuver maintenance" squads fly to EAFs by MV-22s to perform only their specialties. Intermediate-level aircraft maintenance remains organic aboard the ships. "Just-in-time" logistical support brings the essential combat supplies by MV-22s and trucks to keep the EAFs, aircraft and personnel functioning for a few days, preventing large footprints and huge ammo and fuel dumps. Centralized command rests with the JFC. Decentralized control starts with the Joint Force Air Component Commander in conjunction with the MEF and NEF commanders. Squadron commanders run their squadrons and assign EAF liaison officers. Competent squadron logistics officers are key. Secure satellite communications are standard practice. The aircraft's internal all-weather approach capability coupled with differential global positioning provides the pilot safe approach to any EAF. Portable runway lighting, compatible with night-vision devices, is essential. Maneuver air warfare is to STOVL aircraft employment what maneuver warfare is to the Marine Corps.

### ***Conclusion***

Although this scenario represents optimal STOVL utilization with a command and control system that works and favors STOVL aircraft, it demonstrates how STOVL aircraft and employment concepts can contribute to maneuver air warfare in the future. The key to success is

for the Navy-Marine Corps Team to commit *now* to closing the capability gaps with ramps both ashore and afloat. It must develop and refine STOVL employment concepts that include roads, ramps, and smaller EAFs. Finally, it must fund the hardware and structural improvements that allow STOVL aircraft to operate in their intended environment. Only then will STOVL aircraft be equally or exceedingly capable partners in *maneuver air warfare*.

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